reason it would require designing talent of an extremely high order and much serious study to produce a boiler which would not work. Practically all of the boilers which have been built and installed present extremely gross violations of some of the simplest and most elementary laws of physics, not only in the circulation of the heated gases but in the circulation of the water and steam. Owing to their low ruling temperature these boilers work—that is, they produce steam when hot gases pass through them, but their utilization of the heat is comparatively inefficient when the possibilities of such low-temperature applications are considered.

Some three years ago the writer, in the course of a discussion before the Cleveland Engineering Society, stated that it seemed to him that commercial boilers were much better designed for the production of soot, a form of lampblack, than they were for the production of steam. Since then he has seen no occasion to reverse his opinion. At the same time he will admit that the low rate of evaporation presents a certain margin of safety in boiler operation—that is, the operating safety of a steam boiler depends upon the maintenance of the supply of feed water. When the water supply fails a very few minutes elapse before the water in the boiler will be evaporated to a point where portions of the heating surface will become dry. This is the danger point, and the higher the rate of evaporation as compared with the volume of water contained in the boiler, the quicker it will pass this danger line.

When the method of baffling steam boilers is examined, it will be found that the hot gases are introduced at the lowest point of the setting, that these gases rise in two of the passes and drop through the middle pass, and are carried away from the highest point of the setting. Experience with regenerators

and similar heat-absorbing structures has shown that this arrangement of gas passages is absolutely illogical. Some waste-heat boilers without baffling have been installed in connection with copper-smelting furnaces, but in these installations the baffling was removed in order to reduce the resistance to the passage of the gases through the boiler, and the manner in which the gases were introduced and carried away from the setting was not calculated to obtain the best results. The main idea in the design appeared to be that the gases should pass through the boiler setting as rapidly as possible without any consideration of the utilization of their sensible heat, while two boilers were placed in series in order to